ON-SHORE WIND FARM SITE SELECTION IN VIRGINIA

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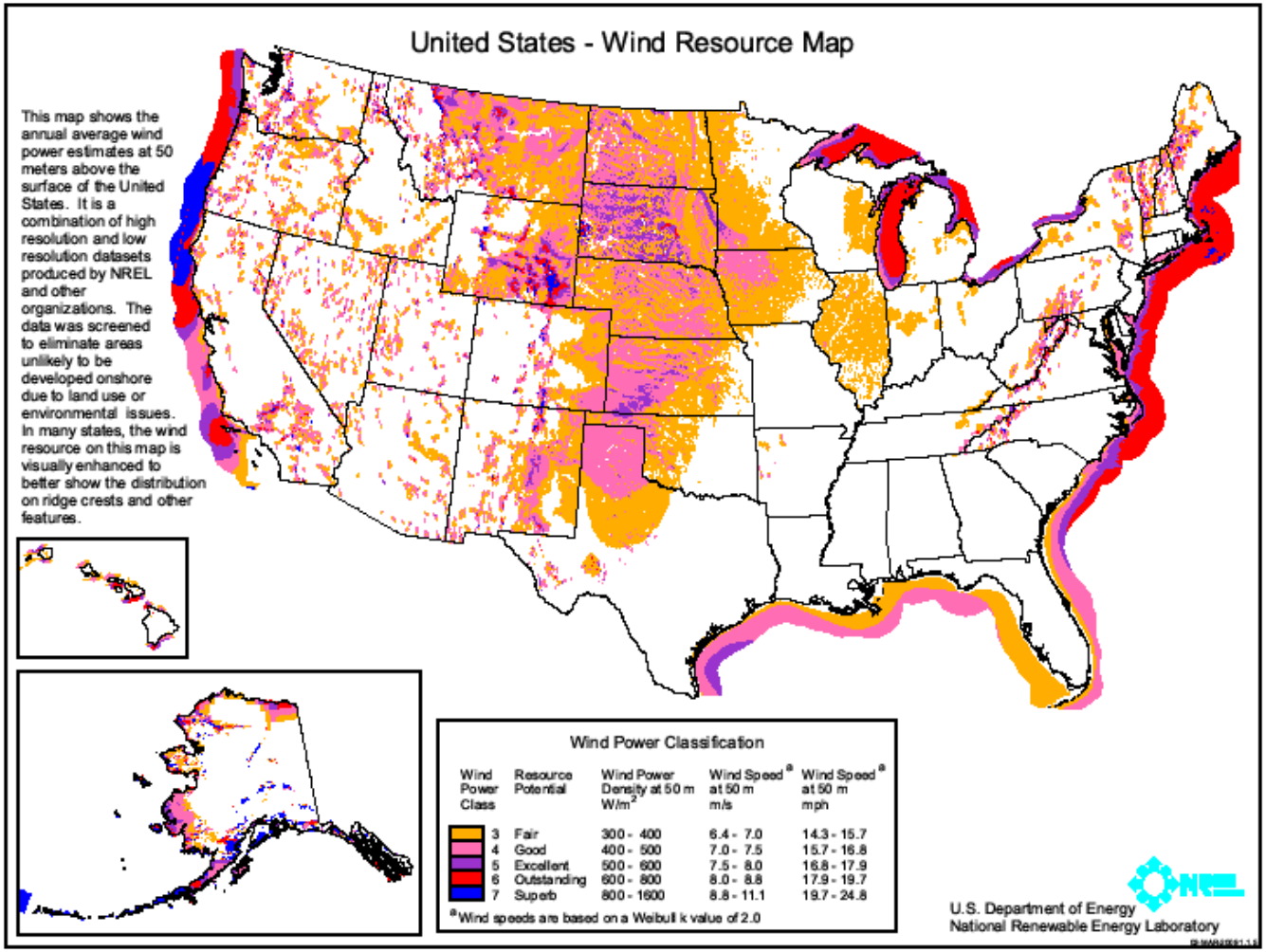
Energy Future

- Increasing energy demand and supply dependencies
- Critical environmental concerns due to unsustainable use of fossil fuels
- Imperative to adopt clean and renewable energy
- U.S. Dept. of Energy : 20% Wind Energy by 2030 scenario

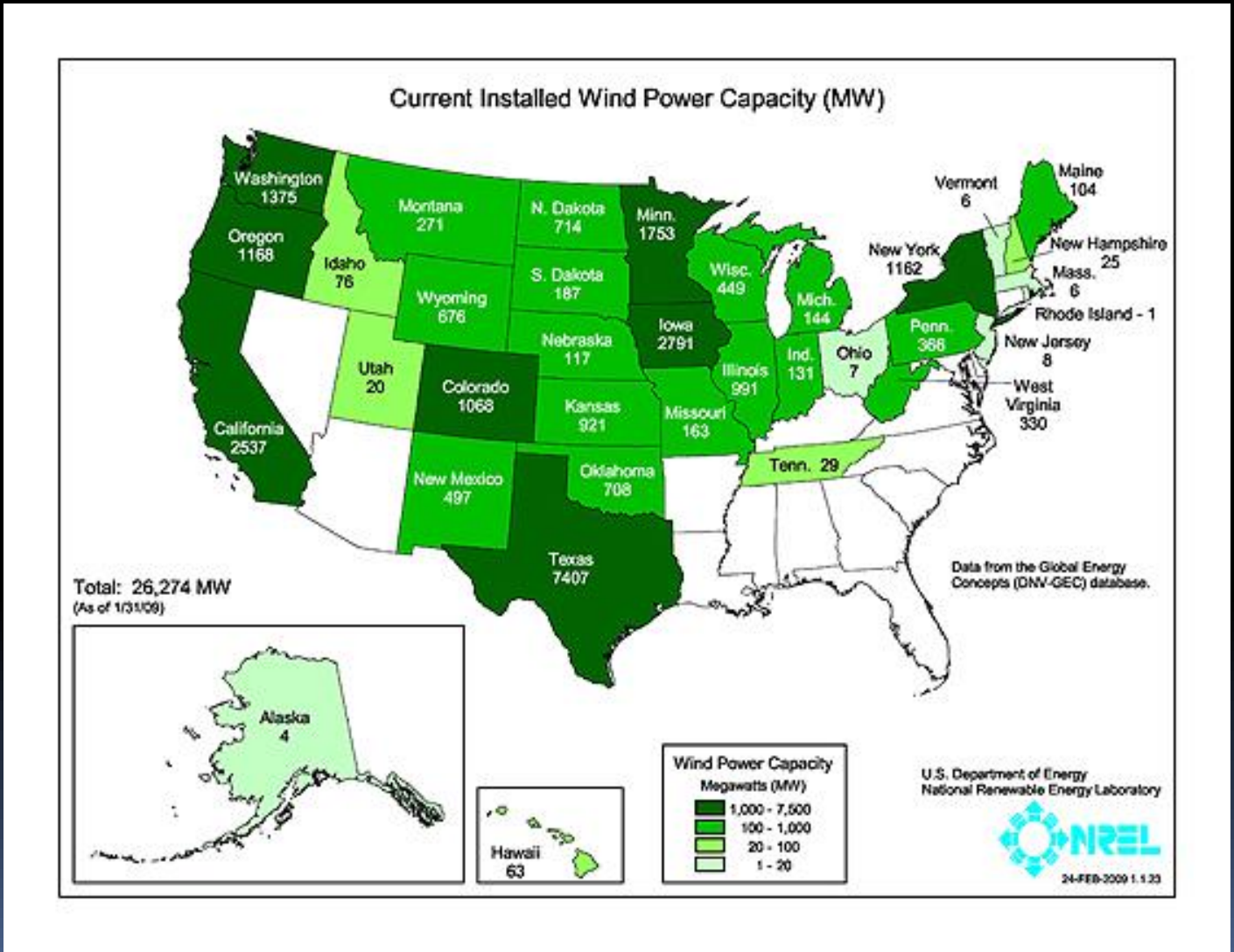
Goals

- Identify potential on-shore locations for wind farm sites in Virginia
- Use GIS for the site selection process
- Create a series of maps to visualize the analysis outcome and recommend sites (if any) meeting selection criteria

United States – Wind Resource



Current Installed Capacity



Methodology

- **Wind resource potential at 50 meters**
  - Wind power class: 1 (poor) – 7 (superb)
- **Constraints – land use, population centers**
  - All land with wind energy resource may not be suitable for wind farm development
  - Issues in populated areas - safety, public opposition, insufficient land
- **Factors – transportation access, transmission lines**
  - Roads for construction, operations, and maintenance
  - Leverage existing energy infrastructure

Data Layers

Data	Source
Wind Resource Potential	National Renewable Energy Laboratory & TrueWind (shapefile generated from original raster data with 200m resolution; 2003)
Conservation Lands (NPS, AT, USFS, USFWS, VA-DCR, VA-DOF, VA-DGIF, Local, Private, The Nature Conservancy) Military Lands (Dept. of Defense)	Virginia Department of Conservation and Recreation (2008) Appalachian Trail Conservancy (2002)
Population	ESRI, Census Bureau (multiple sources; 2004), Appalachian Trail (2002-03)
Roads	Bureau of Transportation Statistics (2008)
Transmission Lines	gecomm.com, Virginia Tech Dept. of Mines, Minerals, and Energy

All data used in the project is publicly available and free.

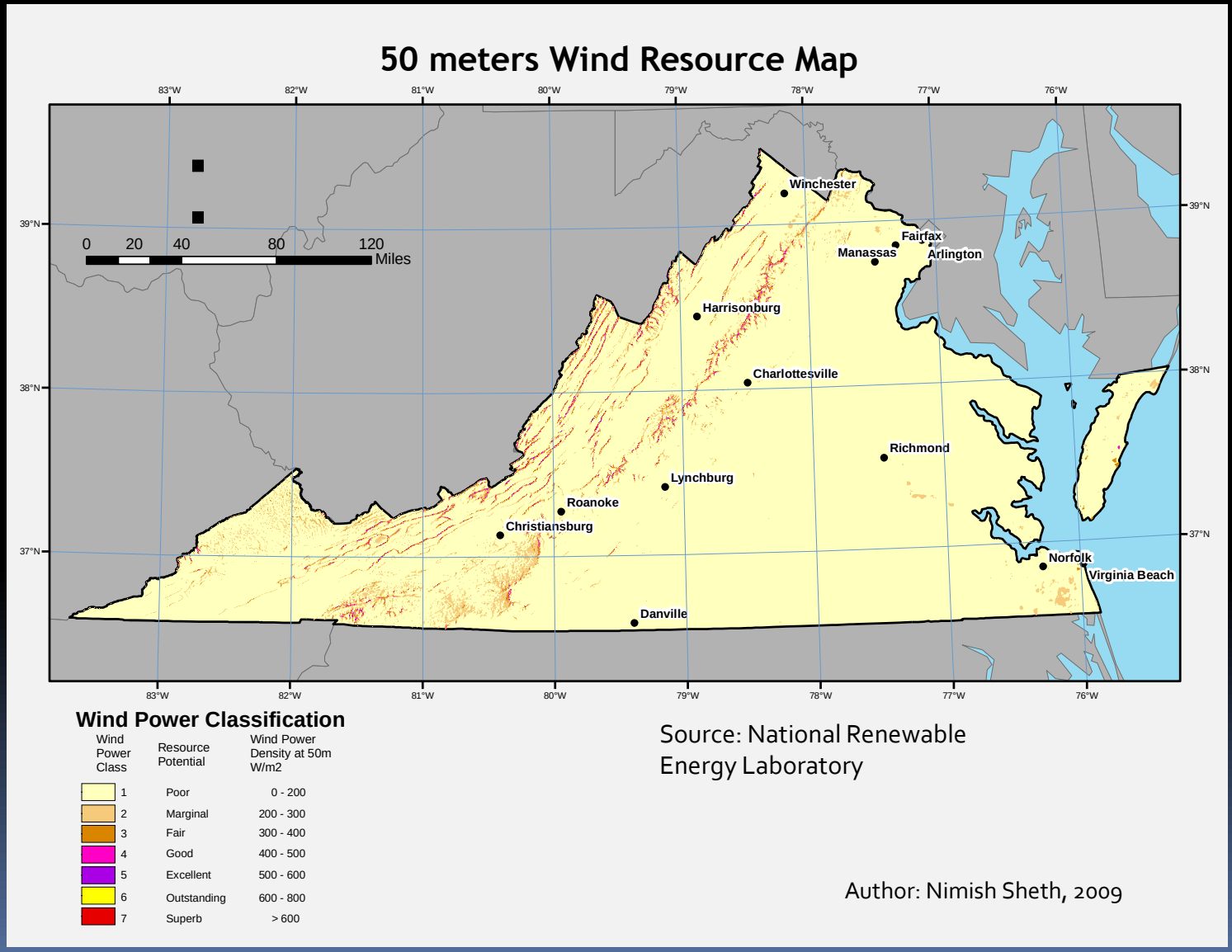
Data Preparation

- Convert layers to GCS - North American Datum 1983; PCS - UTM Zone 17N
- Clip wind resource layer to Virginia
- Set up conservation lands, 10-mile AT buffer, and military areas
- Calculate 2003 population density (per sq. mile)
- Set up major roads – interstates, major roads, and other important arteries
- Transmission lines – digitize high capacity transmission lines from Geocomm.com shapefile and schematic from Virginia Energy Patterns and Trends
- Import, manage, and analyze data in a personal geo-database, after preliminary processing of shapefiles
- Create metadata for new or modified layers (e.g., transmission lines) (overall, good metadata available with all other layers)

Site Selection Process

- Wind power classes 3-7 suitable for utility wind (exclude areas with wind class 1-2)
- Exclude conservation lands
- Exclude counties with population density > 500
- Select areas within 5 miles of roads
- Select areas within 10 miles of transmission lines.

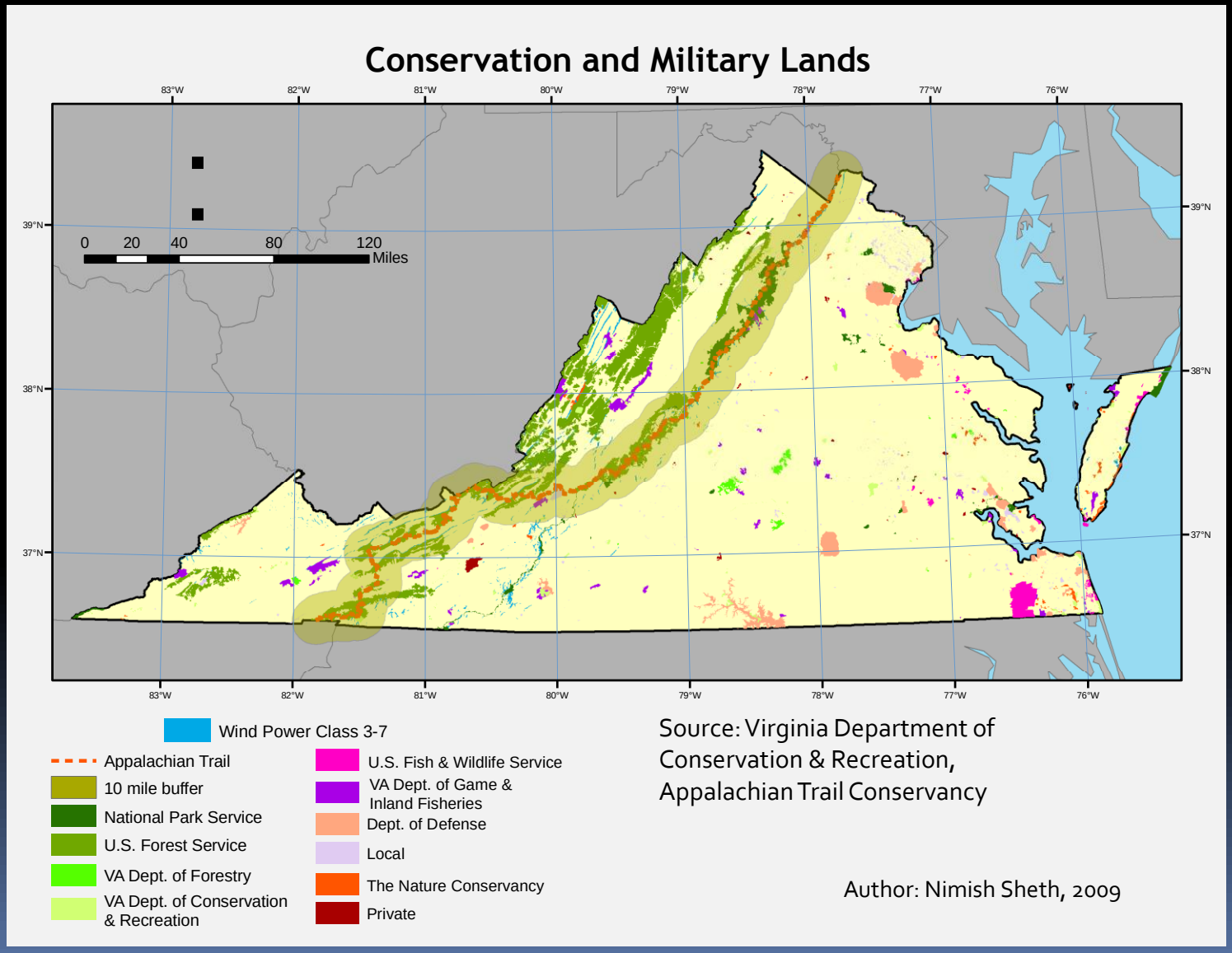
Virginia Wind Resource Potential



Source: National Renewable Energy Laboratory

Author: Nimish Sheth, 2009

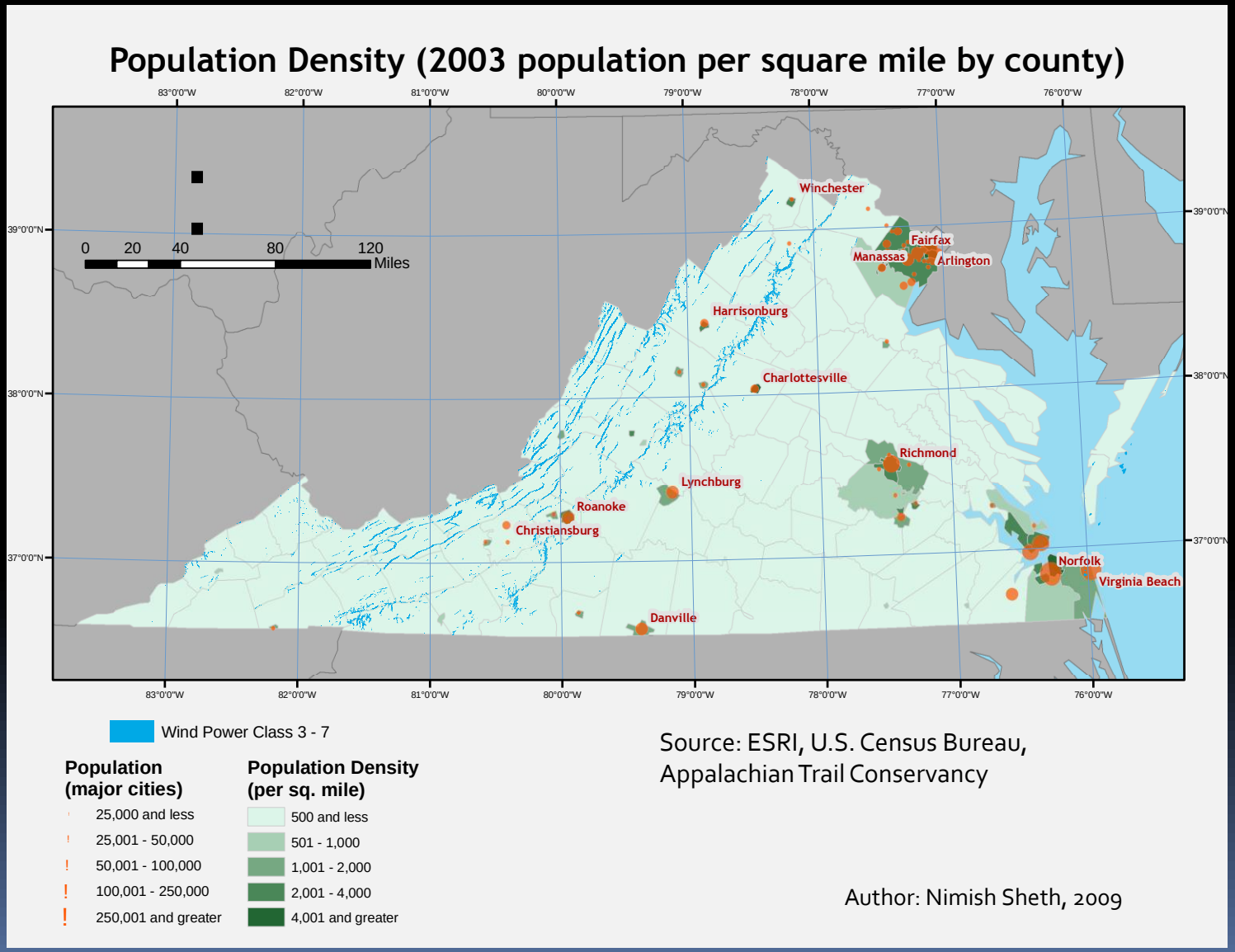
Land Use Constraints



Source: Virginia Department of Conservation & Recreation, Appalachian Trail Conservancy

Author: Nimish Sheth, 2009

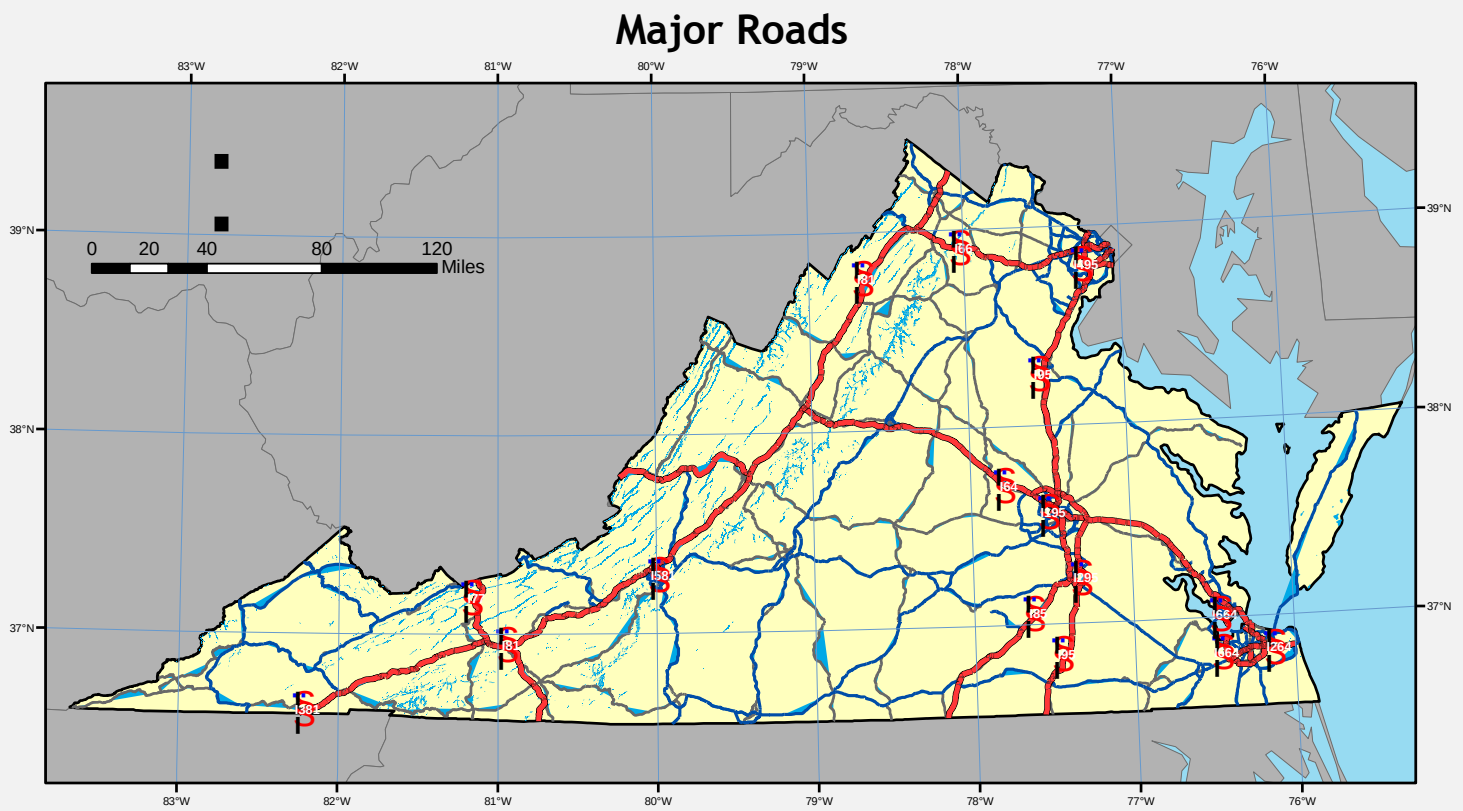
Away from Population Centers



Source: ESRI, U.S. Census Bureau, Appalachian Trail Conservancy

Author: Nimish Sheth, 2009

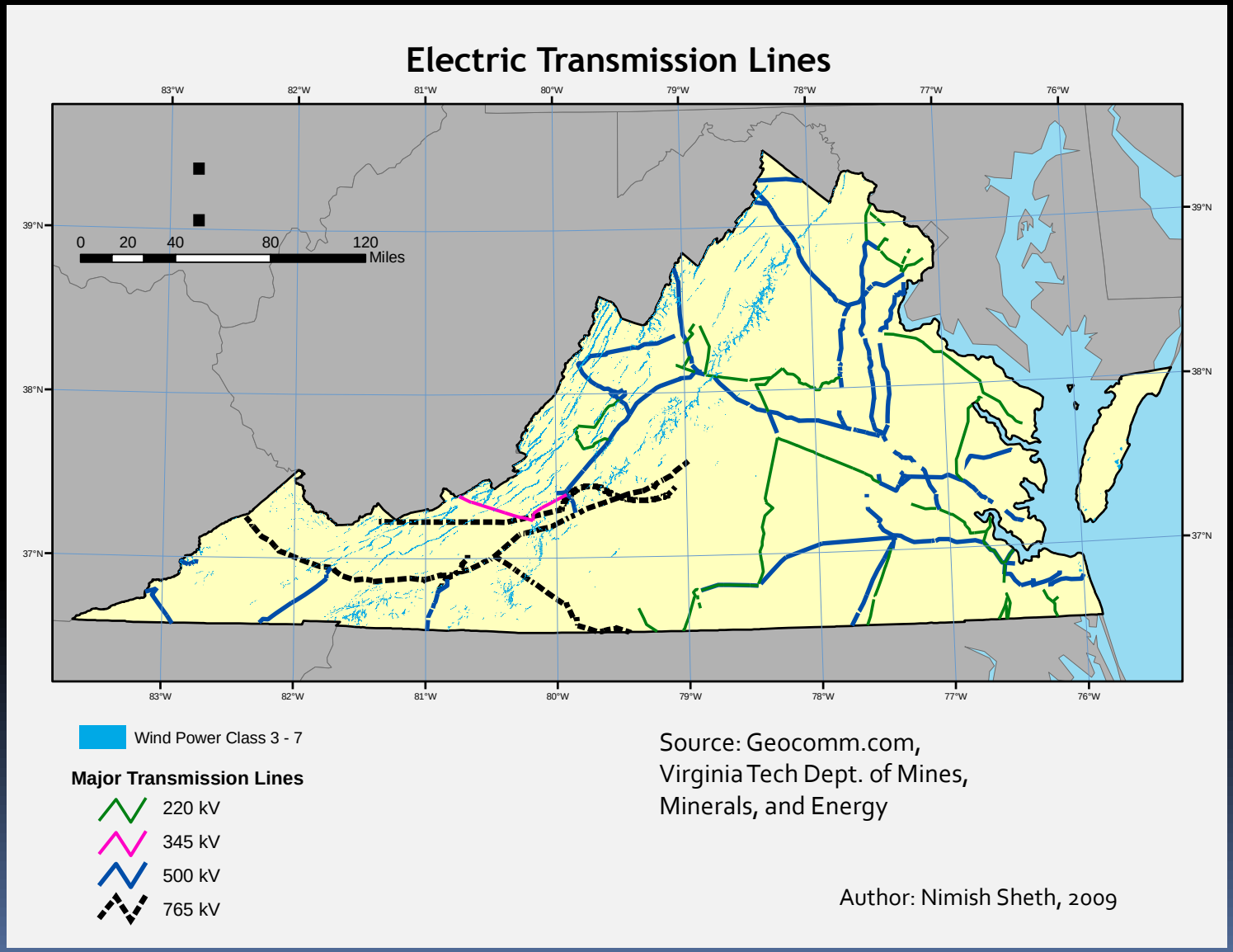
Proximity to Roads



Source: Bureau of Transportation Statistics – National Transportation Atlas Database

Author: Nimish Sheth, 2009

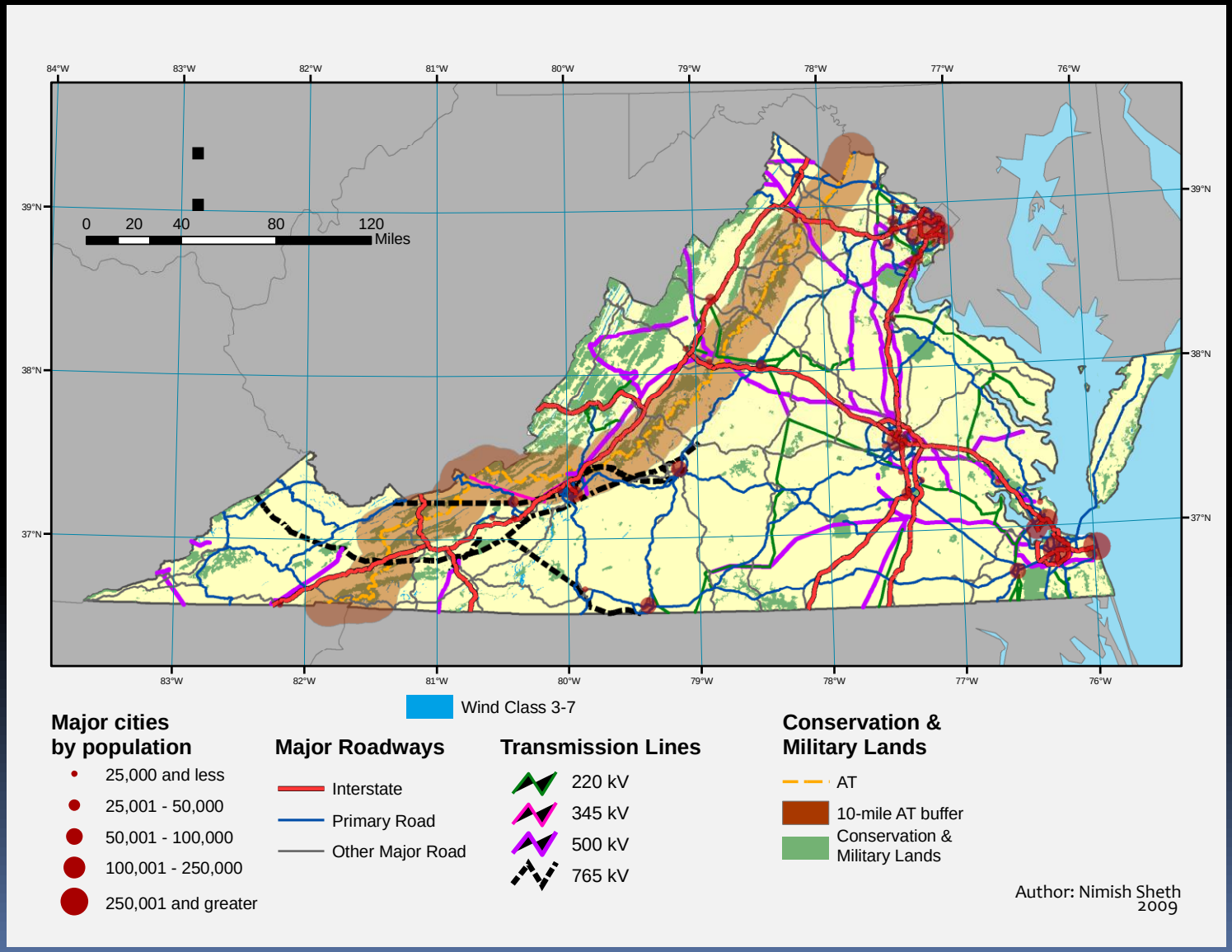
Proximity to Transmission Lines



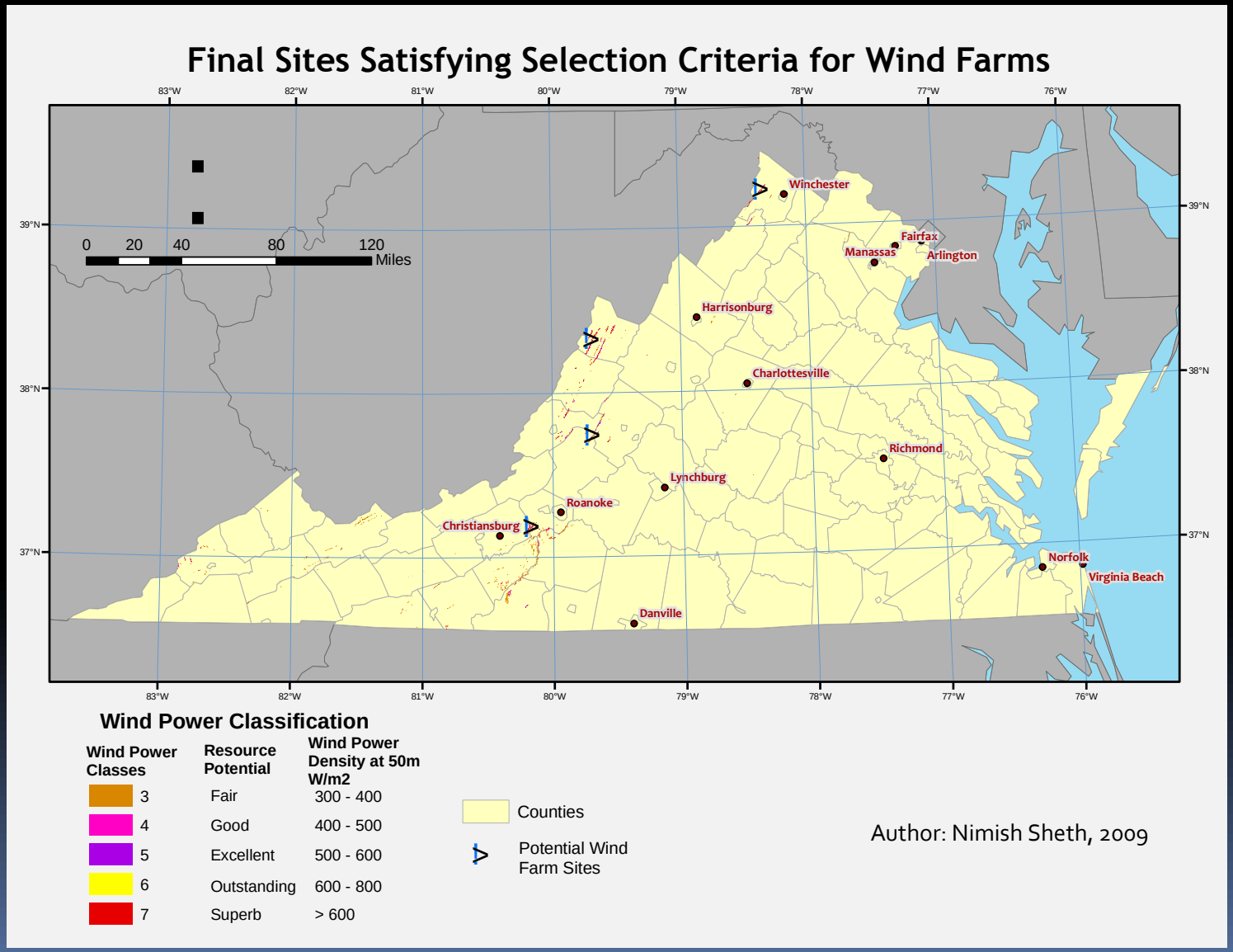
Source: Geocomm.com, Virginia Tech Dept. of Mines, Minerals, and Energy

Author: Nimish Sheth, 2009

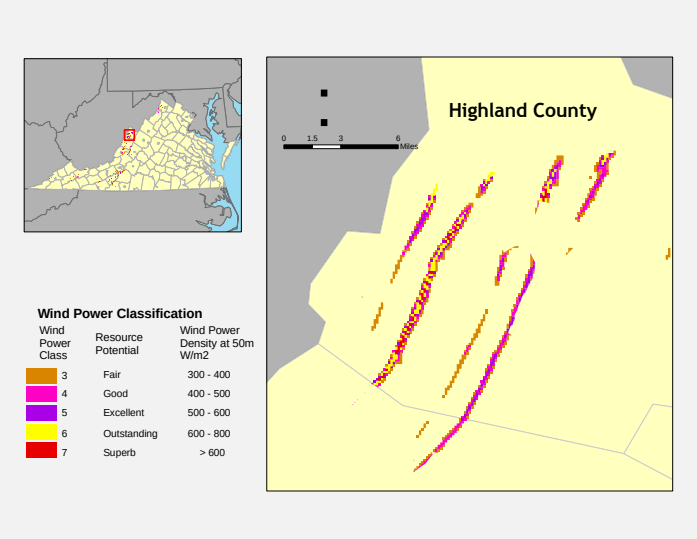
All Layers Combined

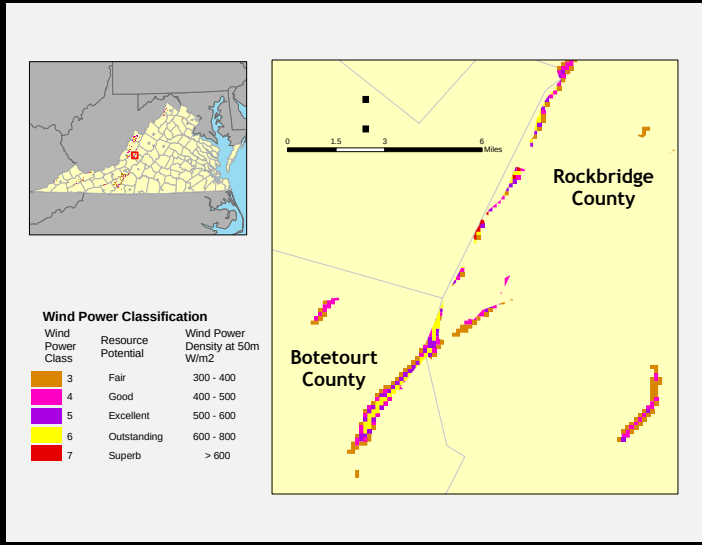


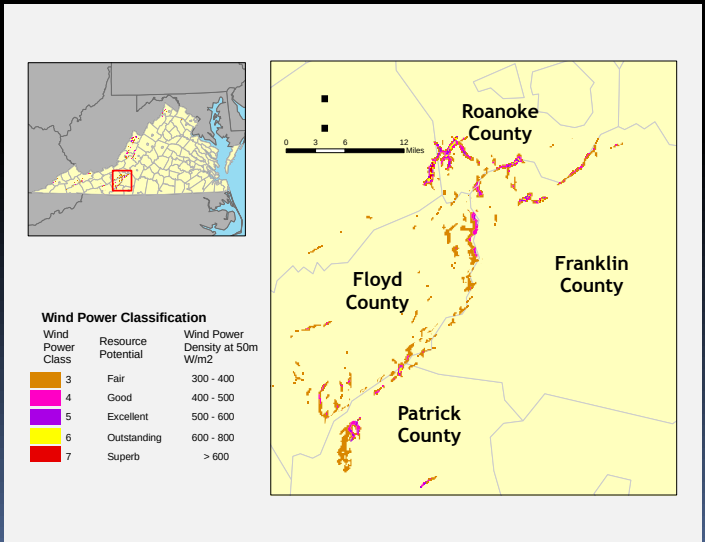
Proposed Sites

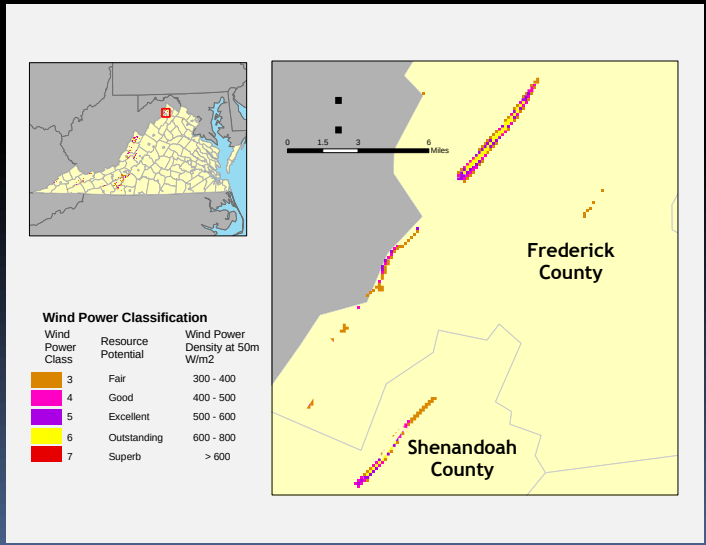


Proposed Sites (cont.)









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Limitations

- Site capacity
- Slope
- Vegetation and Soil
- Terrain orientation to prevailing wind (parallel v. perpendicular)
- Airports
- Water bodies
- Cost-benefit analysis
- Avian and wildlife Impact – population, migration routes
- Landowner concerns
- Visual impacts

Future Analysis

- Offshore Wind
- 70m – 100m wind potential for new technology turbines